NJIT Spring - 2024

INSTRUCTOR: Rima Taher, PhD, PE, Senior University Lecturer

ARCH 304-002: Structures II

Face-to-Face Instruction: Tuesday & Friday from 10:00 to 11:20 am – WLH1

Learning Management System: https://canvas.njit.edu

COURSE OVERVIEW:

This course introduces the students to the basic principles of structural analysis and design using traditional structural materials such as steel, reinforced concrete and wood. It uses a practical and simplified approach combined with computerized methods of analysis and design to teach students how to make some basic structural decisions regarding their designs. The course also outlines the principles of designing for lateral forces and lateral stability in high-rise structures, and uses examples of tall buildings to illustrate these concepts. The various types of foundation systems and retaining walls are also covered. Some case studies of complex buildings and structures are introduced. The design procedures and computerized applications covered in this course are based on the latest codes and standards. Structural topics are illustrated using examples from real life construction projects.

PREREQUISITES:

Structures I (Arch 303)

LEARNING OUTCOMES:

1) Develop the ability to select a structural system for a building, and layout a typical floor or roof framing.

2) Develop the ability to use some established rules of thumb for the selection of structural members.

3) Develop skills for using some analytical methods to help prove the design decisions beyond the general rules of thumb.

4) Develop the ability to structurally design simple structural elements such as joists, beams and columns.

4) Develop the ability to apply the theoretical concepts and methods using some practical design assignments and a main steel building project.

5) Develop the skills to use computer programs such as Revit and the Vitruvius Project through the work assigned in the main project.

NAAB Program Criteria

The National Architectural Accrediting Board (NAAB) accredits NJIT's architecture program. The NAAB has criteria that must be covered by any architectural curriculum to attain their approval. This course directly addresses (all or in part) the following, as outlined in the 2020 NAAB Conditions for Accreditation:

PC.2 Design—How the program instills in students the role of the design process in shaping the built environment and conveys the methods by which design processes integrate multiple factors, in different settings and scales of development, from buildings to cities.

PC.3 Ecological Knowledge and Responsibility—How the program instills in students a

holistic understanding of the dynamic between built and natural environments, enabling future architects to mitigate climate change responsibly by leveraging ecological, advanced building performance, adaptation, and resilience principles in their work and advocacy activities.

PC.6 Leadership and Collaboration—How the program ensures that students understand approaches to leadership in multidisciplinary teams, diverse stakeholder constituents, and dynamic physical and social contexts, and learn how to apply effective collaboration skills to solve complex problems.

PC.7 Learning and Teaching Culture—How the program fosters and ensures a positive and respectful environment that encourages optimism, respect, sharing, engagement, and innovation among its faculty, students, administration, and staff.

NAAB Student Criteria

SC.1 Health, Safety, and Welfare in the Built Environment—How the program ensures that students understand the impact of the built environment on human health, safety, and welfare at multiple scales, from buildings to cities.

SC.2 Professional Practice—How the program ensures that students understand professional ethics, the regulatory requirements, the fundamental business processes relevant to architecture practice in the United States, and the forces influencing change in these subjects.

SC.3 Regulatory Context—How the program ensures that students understand the fundamental principles of life safety, land use, and current laws and regulations that apply to buildings and sites in the United States, and the evaluative process architects use to comply with those laws and regulations as part of a project.

SC.4 Technical Knowledge—How the program ensures that students understand the established and emerging systems, technologies, and assemblies of building construction, and the methods and criteria architects use to assess those technologies against the design, economics, and performance objectives of projects.

SC.6 Building Integration—How the program ensures that students develop the ability to make design decisions within architectural projects while demonstrating integration of building envelope systems and assemblies, structural systems, environmental control systems, life safety systems, and the measurable outcomes of building performance.

LEARNING AND TEACHING CULTURE POLICY

In addition to the overarching values and ethics of the university, the New Jersey School of Architecture (NJSoA) is dedicated to optimism, diversity and solidarity, professional conduct, constructive evaluation and instruction, collaborative community, health and wellbeing, time management and school-lifework balance, respectful stewardship and space management, and well-rounded enrichment. The pedagogy of architecture and design is as complex as it is rewarding, and as dynamically evolving as the people who learn and teach it. This understanding resides at the core of the NJIT Learning and Teaching Culture Policy: https://design.njit.edu/learning-and-teaching-culture-policy

COURSE REQUIREMENTS - CANVAS:

Students are expected to take a test, a mid-term examination, and a final examination, in addition to some homework assignments and a main project.

Students can access Canvas using their UCID and password. Assignments and other course material will be posted to Canvas. Students are required to upload their assignment files to Canvas in PDF format only by the posted due date. A grace period of 24 hours after the due date is granted with a penalty. No assignments will be accepted past the grace period. Students should not e-mail their homework files to the instructor. All e-mailed assignment files will be ignored and deleted. Assignments will be graded on Canvas. Grades and comments will also be posted on Canvas.

Tests and exams will be given in class. Some tests will consist in two parts: a closed-book part with questions to answer, and an open-book part with a few problems to solve. Students can use their textbook and their notes for the open-book part only. The use of electronic devices will not be permitted during the tests. Only a basic scientific non-communicating calculator will be allowed. All students are expected to take the tests at the scheduled time. No make-up test or exam will be given if students do not show up as scheduled unless the student has a compelling and valid reason that can be substantiated. Proof of hardship must be presented to the Dean of Students.

Students enrolled in this course are not to schedule vacation and holiday trips while the course is ongoing, and on dates that coincide with test dates. The course will end after the final exam is given. Airline tickets must not be purchased before the final exam date. The final exam week is from May 3 to May 9.

Attendance is mandatory and an attendance record will be kept. The instructor can lower the student's grade based on the attendance record as permitted by the university policies.

MEANS OF EVALUATION:

Students are expected to take a test, a mid-term examination and a final examination, in addition to some homework assignments and a main project. The weight of the various required tests and assignments along with some tentative test dates are given below:

Test 1: 20% - Tentative date: Friday February 9
Mid-Term Examination: 25% - Tentative date: Tuesday March 19
Assignments: 10% - Due dates to be announced and posted on Canvas.
Project: 15% - Tentative Due Date: April 20
Final Examination: 30% - During the final exam week from May 3 to May 9

The following grades are used for undergraduate students:

Grade	Description
A	Superior
B+	Excellent
B	Very Good
C+	Good

C	Acceptable
D	Minimum
F	Inadequate
AUD	Audit
I	Incomplete--given in rare instances to students who would normally have completed the course work but who could not do so because of special circumstances. It is expected that coursework will be completed during the next regular semester. If this grade is not removed before final grades are due at the end of the next regular semester, a grade of F will be issued.
W	Withdrawal
S	Satisfactory
U	Unsatisfactory

Grading Scale

A: 100-90, B+: 89-85, B: 84-80, C+: 79-75, C: 74-70, D: 69-60, F: Below 60

REQUIRED TEXT:

1. Simplified Structural Analysis and Design for Architects, Revised Second Edition, by Rima Taher, Cognella, Inc., ISBN # 978-1-5165-1057-3
   The publisher makes this book available to purchase online at the best price. Instructions for online ordering of this textbook are posted to Canvas.

2. The Structural Basis of Architecture, by Sandaker, Eggen and Cruvellier, 2nd Edition, published by Routledge, 2011. This book can be accessed online free of charge using the web link below with the NJIT- UCID and password: https://ebookcentral.proquest.com/lib/njit/detail.action?docID=1111702.

USEFUL REFERENCES:

1. Structural Steel Design, 5th Edition, by Jack C. McCormack and Stephen Csernak, Pearson, Prentice Hall, 2012
2. Manual of Steel Construction, 15th Edition, by the American Institute of Steel Construction (AISC), Chicago, Illinois, 2016
3. Building Design for Wind Forces, by Rima Taher, McGraw Hill Education, 2019.
4. Design of Wood Structures, 8th Edition, by Donald Breyer, Kelly Cobeen, Zeno Martin, McGraw Hill, 2020
5. Structural Steel Drafting & Design, 2nd Edition, by David McLaughlin and Hector Estrada, Cengage Learning, 2009
6. Simplified Engineering for Architects and Builders, 11th Edition, by James Ambrose and Patrick Tripeny, Wiley & Sons, 2011
7. Building Construction Illustrated, 4th Edition, by Francis D.K. Ching, Wiley, 2008

8. Structural Design – A Practical Guide for Architects, 2nd Edition, by Rod Underwood and Michele Chiuini, John Wiley $ Sons, 2007
9. The Architect Studio Companion – Rules of Thumb for Preliminary Design, 6th Edition, by Edward Allen and Joseph Iano, Wiley & Sons, 2017
10. Shaping Structures – Statics, 1st Edition, by Waclaw Zalewski and Edward Allen, Wiley & Sons, 1998
11. Steel, Concrete and Composite Design of Tall Buildings, 2nd Edition, by Bungale S. Taranath, McGraw Hill, 1997

CODES AND STANDARDS:

1. The 2021 International Building Code (IBC) published by ICC, International Code Council
2. Minimum Design Loads and Associated Criteria for Buildings and Other Structures, ASCE 7-2022, by the American Society of Civil Engineers
3. The 2016-AISC Specification and the 15th Edition of the Manual of Steel Construction by AISC, American Institute of Steel Construction
4. National Design Specification for Wood Construction (NDS), 2018, by the American Wood Council
5. Building Code Requirements for Structural Concrete and Commentary, ACI 318-19, by the American Concrete Institute 2019.

INSTRUCTOR:

Rima Taher, PhD, PE, Senior University Lecturer
The instructor will be available for counseling on Tuesday and Friday from 11:45 to 12:30 pm or by appointment.
Office Number: Weston 521
Phone: 973-596-3015
E-mail address: Taher@njit.edu

ACADEMIC INTEGRITY:

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: ***http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf***.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

ATTENDANCE POLICY

Attendance is critical and an attendance record will be kept in this course. The instructor has the right to lower the student's grade by one half grade (for example from A to B+) for every class missed. Students need to notify the instructor when absent and explain the reason for not attending.

The NJIT office of the Dean of Students (DOS) also maintains a way for students to explain absences that instructors can use to regulate absenteeism by providing verifiable documentation through filing an

online Student Absence Excuse Request form related to the absences within 14 days. The DOS will communicate with the instructor. Nonetheless, the DOS only verifies documentation, and it remains the instructor's discretion to provide any accommodation and the student's responsibility to follow up with the instructor. Accepted reasons for absence include bereavement, medical concerns, military activity, legal obligations, or university-sponsored events. Additional DOS information is outlined here: https://www.njit.edu/dos/student-excusals

WEEK-BY-WEEK SCHEDULE:

Week	Date	Topic/*Assignment*
1	1/14 to 1/20	Introduction, Loads, Codes and Standards, Review of Structural Analysis: Support Reactions
2	1/21 to 1/27	Structural Analysis Continued: Shear and Bending Moment
3	1/28 to 2/3	Design Loads, Snow Load, Live Load Reduction, Examples Load Combinations, LRFD Load Combinations, ASD Load Combinations, Examples
4	2/4 to 2/10	Load Combinations, LRFD Load Combinations, ASD Load Combinations, Examples **Test 1: Friday February 9**
5	2/11 to 2/17	Truss Analysis, Method of Joints, Examples
6	2/18 to 2/24	Truss Analysis Continued, Method of Sections, Examples Introduction to Lateral Loads: Wind and Earthquake Forces Lateral Stability in High-Rise buildings, Basic Structural Systems Used in High-Rise Construction, Examples of Steel and Concrete High-Rises
7		Steel Structures: Structural Steels, Properties, Structural Shapes, Steel Systems and Rules of Thumb, Basic Steel Framing Plans Steel Beam Behavior and Design Principles: Bending, Lateral Stability of

	2/25 to 3/2	Beams, Design Examples
8	3/3 to 3/9	Steel Beam Design Continued, Shear and Deflection, Design Examples
9	3/10 to 3/16	**Spring Recess – No Class**
10	3/17 to 3/23	**Mid-Term Examination: Tuesday March 19** Steel Beam Design Continued, Shear and Deflection, Design Examples
11	3/24 to 3/30	Column Behavior, Column Shapes, Column Buckling and Slenderness Ratio, Axially Loaded Columns, Eccentrically Loaded Columns, Design of Axially Loaded Columns, Design Examples **Friday 3/29: Good Friday – No Class**
12	3/31 to 4/6	**Last Day to Withdraw: Monday April 1st.** **Project Assigned:** Computerized Design of a Typical Steel Building Using Revit and StruCalc Project Program, Examples of Building Projects Design of Open-Web Joists, Metal Decks - Steel Connections and Connection Details: Bolted Connections, Welded Connections **Case Studies of Complex Buildings and Structures** Seattle Central Library
13	4/7 to 4/13	**Case Studies of Complex Buildings and Structures (Continued)** Walt Disney Concert Hall, Milwaukee Art Museum Addition Wood Structures: Wood Buildings & Design Criteria, Lumber and Lumber Grades, glulam, Engineered Wood Products (I-Joists, LVL and PSL)
14	4/14 to 4/20	**Project Tentative Due Date: Saturday April 20** Simplified Design of Wood Beams
15	4/21 to 4/27	Reinforced Concrete Structures, Materials for Reinforced Concrete, Main ACI-Code Requirements, Rules of Thumb, Design of Concrete Beams Foundation Systems: Soil Properties and Soil Classification System, Soil Investigations, Borings and Test Pits, Soil Bearing Capacities, Spread Footings, Piles
16	4/28 to 5/4	Retaining Walls: Types (Gravity, Cantilever and Counterfort Walls), Wall Equilibrium and Safety Factors, Common Types of Wall Failures by

		Sliding, Overturning and Breaking – Segmental Retaining Walls **Last Day of Class at NJIT: Tuesday 4/30 – Friday Schedule** **Reading Day 1: Wednesday May 1st** **Reading Day 2: Thursday May 2nd** **Last Lecture: Tuesday 4/30**
17		**Final Exam Week: From Friday May 3 to Thursday May 9**